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Paronychia Treatment: Formulation and Evaluation of Polyherbal Cream

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Abstract

A perionychium abscess or localized superficial infection is called a paronychia. Swollen, erythematous, and Tender nail folds are its defining features. They mostly fall into two categories: Acute and chronic. The majority of people having acute paronychia Caused by their biting nails.

A soft tissue infection surrounding a fingernail is called paronychia. Specifically, it is an initial cellulitis-like superficial infection of the epithelium lateral to the nail plate that might develop into a clear abscess. Acute and chronic paronychia are two distinct conditions that are frequently treated differently and have different etiologist, infectious agents, and courses of therapy. There are two kinds of paronychia: 1. Acute paronychia Staphylococci are usually the source of this painful and purulent ailment; fungal infections are often the cause of chronic paronychia.

Although mixed aerobic and anaerobic flora are usually present, staphylococci are the most prevalent cause of the painful, purulent an acute condition. A straightforward drainage operation significantly improves the patient's health and level of discomfort. Chronic paronychial infections are usually fungal, rather than bacterial, in nature.

The main microbe that causes illness is Staphylococcus aureus, or S. aureus. Acute paronychia can also be caused by pseudomonas and anaerobes. Chronic paronychia is a persistent type of conditions that primarily affects those who have been clinically exposed to alkali, water, etc. Chronic paronychia originates mainly from Candida albicans (C. albicans). Chronic paronychia can also be caused by other infections, such as gram-negative rods, gram-negative cocci, and atypical mycobacteria.

Topical therapy, oral medication, surgical avulsion, laser treatment, and additional approaches are now available for treatment. This research article covers the perionychium's anatomy, paronychia's categorization, preventative strategies, paronychia's current treatment options and new polyherbal formulation for their treatment. Of these illnesses, 35% are caused by paronychia, which is the most frequent hand infection in the US. With a 3:1 female to male ratio, the infection is more frequent in women than in males.

Aim: This study aimed to develop and assess the efficacy, safety, and stability of an herbal cream formulated for the treatment of paronychia.

Objective: The objective of this study was to develop a polyherbal cream for the treatment of parenchyma disorders.

Purpose: The purpose of this research was to formulate and evaluate a polyherbal cream with selected herbs known for their pharmacological properties targeting parenchymal tissues.

Result: The cream was formulated using selected herbal extracts known for their antimicrobial activity. Evaluation of efficacy to determine antimicrobial activity against common pathogens causing paronychia. Safety assessments included skin irritation tests, allergic reaction assessments, and microbiological analyses to ensure the cream's safety profile. Stability studies were conducted under various storage conditions to assess the cream's shelf-life and efficacy over time. Results demonstrated significant antimicrobial and anti-inflammatory properties of the herbal cream, with no observed adverse effects in safety evaluations. Stability studies indicated satisfactory shelf-life under recommended storage conditions. This herbal cream shows promise as a safe and effective alternative for the treatment of paronychia, warranting further clinical trials for validation.

Keywords: Paronychia, Treatment, Nail, perionychium, Disease, Pathogens, Nail Disorder, Staphylococcus Aureus, Topical Therapy, Oral Medication, Surgical Avulsion, Laser Treatment

Introduction

Greek word παρωνυχία is the source of the word paronychia. IA means condition, para means beside of, and onyx means nail. The lateral nail fold's edema and erythema are the initial indications of a paronychium. This might develop into an abscess that surrounds the lateral and proximal nail folds if treatment is not received. Another name for paronychia is Whitlow [1]. First of all, an infection of the proximal or lateral tissue folds around a toe or finger nail is known as paronychia. The most common cause of infectious paronychia is the breakdown of the barrier that protects the nail from the nail fold. Bacterial or fungal infections occur when organisms enter the sulcus between the nail and the nail fold. The aetiology and therapy of paronychia vary depending on whether it is acute or chronic. It is best to treat the two kinds as entirely distinct entities.

Due to the paucity of research on paronychia in the toe, the majority of the material reviewed here is with paronychia of the finger. There are significant parallels between both upper and lower extremities in terms of appearance and therapy. As a result, this material is definitely applicable and generalizable. However, when treating this ailment, it's crucial to take into account some foot-specific factors. An overview of toenail paronychia is provided in this study, along with a suggested treatment plan (Fig.1) [2].

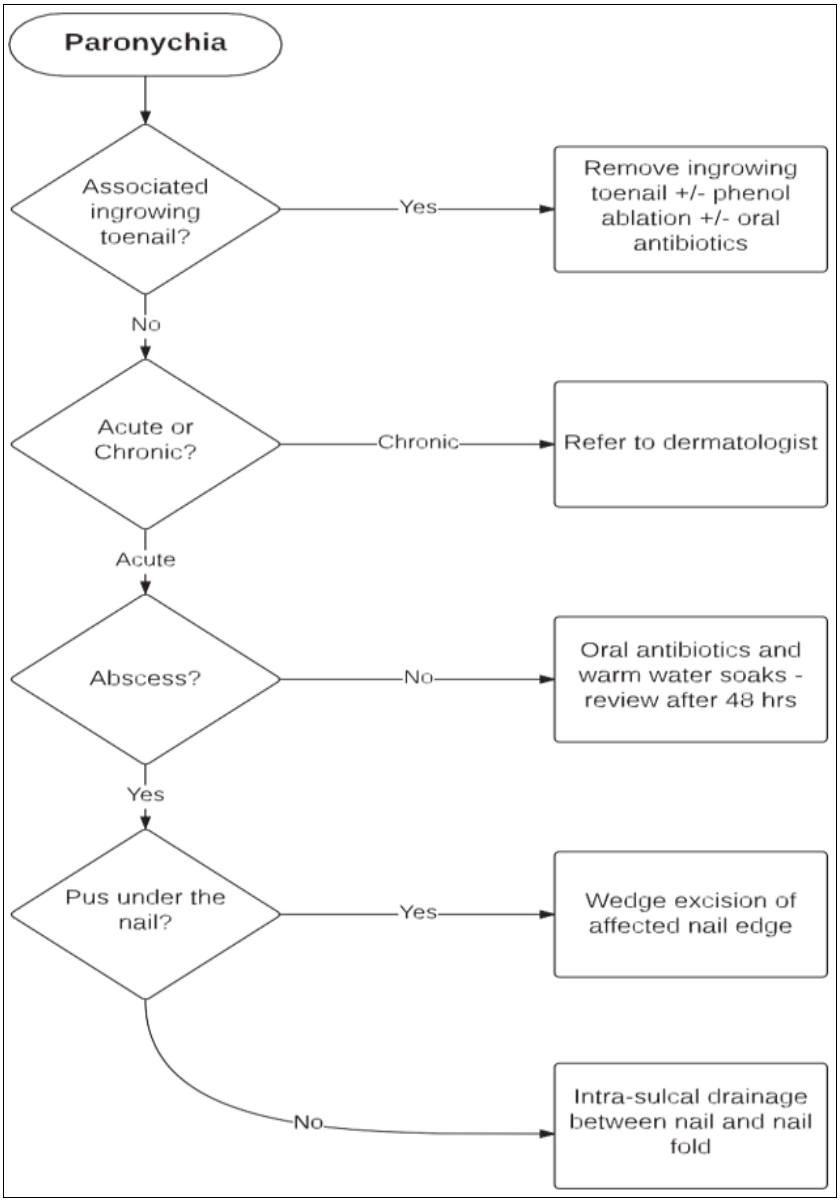

Fig 1: Algorithm for the management of paronychia

Microbiology

The majority of paronychia microbiological investigations have focused on aerobic bacterial culture. The isolation of Proteus species, Candida albicans, Pseudomonas aeruginosa, coliform organisms, Staphylococcus aureus, and Streptococcus faecalis from this infection has been documented in these papers. Two studies that used methods for recovering both aerobic and anaerobic microorganisms examined the paronychia microbiology in 61 patients—33 of whom were children and 28 of whom were adults. They gave an example of paronychia's mixed aerobic and anaerobic bacteriology. Thirty patients (49%), only seventeen patients (28%), and fourteen patients (23%), had mixed aerobic and anaerobic flora. Anaerobic organisms were recovered in pure culture. There were 190 isolates found in all, or 3.1 isolates for each specimen. Fusobacterium species, Gram-positive anaerobic cocci, and Bacteroides species were the most common anaerobic organisms. Staphylococcus aureus, Group A beta-haemolytic streptococci, Eikenella corrodens, gamma-haemolytic streptococci, and Klebsiella pneumoniae were the most common aerobic organisms [3].

Table 1: Microbiology

Aerobic, facultative and Candida isolates Gram-positive cocci		**Anaerobic isolates**	
Group A beta-haemolytic streptococci	06	Pepto streptococcus species	42
Group D streptococci	05	Fusobacterium species	19
Staphylococcus aureus	21	Bacteroides species	21
Klebsiella pneumoniae	04	Bacteroides fragilis	03
Eikenella corrodens	07	Pigmented Prevotella	07
Candida albians	10	Porphyromonas group	07
Total	**84**	**Total**	**106**

Pathogenesis

It is clear that polymicrobial aerobic and anaerobic flora are present in paronychia. These floras are known to work in concert, making the illness more difficult to treat. The majority of isolates are anaerobic bacteria, which outweigh aerobes by a ratio of 4:1. While one-third of the patients had S. aureus found in their lesions, the majority had a combination of both anaerobic and aerobic bacteria found in their lesions. The isolated anaerobic organisms, which include pigmented Prevotella and Porphynomonas, Gram-positive anaerobic cocci, and fusobacteria, are typical oropharyngeal flora and might be a result of the patient's own oral flora self-inoculation onto the finger. Biting one's nails and sucking one's fingers are frequent childhood behaviours that can also happen to adulthood. Through the simple inoculation on the fingers with oral flora, where anaerobes outweigh aerobes in a ratio of 10:1, this predisposes to paronychia. This is similar to how infections spread after bites from humans and injuries from clinched fists. About half of the patients in investigations involving the cultivation of aerobic and anaerobic microorganisms in such illnesses had anaerobic organisms retrieved from them. Staphylococcus aureus, Eikenella corrodens, and group A streptococci were the most common aerobic isolates. Fusobacterium nucleatum, Gram-positive anaerobic cocci, and Bacteroides species were the most frequently isolated anaerobic microorganisms [3].

Nail

The nail folds, which originate at the matrix of nails and adhere to the nail bed, hold the nail in place as a window into the nail bed. It terminates at a distant free edge. It is located next to the distal interphalangeal junction at its proximal edge. The shared biological and surgical processes affecting these two structures are relevant to the 1.2 mm location of this joint's extensor tendon insertion. The surface markers of the matrix's boundaries appear to be located at 75% of the distance between the cuticle and the fold of the interphalangeal joint at the distal end and laterally to the sagittal midline of the digit, according to serial dissections of 19 fingers. Anatomical terms are illustrated in Fig. 2A &B.

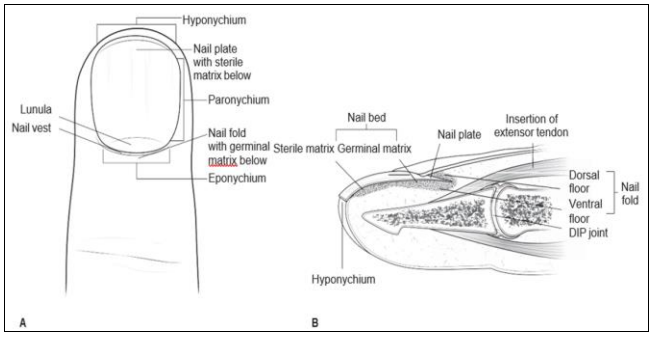

Fig 2: Illustrations of dorsal (A) and cross-section (B) views of the anatomy of the fingertip and nail bed

- **The definitions of the components of the nail unit are as follows:**
- ***Nail plate (nail):*** Durable keratinized structure which continues growing throughout life.
- ***Lateral nail folds:*** The cutaneous folded structures providing the lateral borders to the nail.
- ***Proximal nail fold (posterior nail fold):*** Cutaneous folded structure providing the visible proximal border of the nail, continuous with the cuticle. On the lower portion of the undersurface, this becomes the dorsal matrix.
- ***Eponychium:*** Refers to the upper portion of the ventral aspect of the proximal of the proximal nail fold and adheres closely to the nail for a short distance.
- ***Cuticle:*** The stratum corneum of both the dorsal and ventral side of the proximal nail fold forms a gradually desquamating tissue that seals the nail cul-de-sac.
- ***Nail matrix (nail root):*** The matrix (germinative matrix) is the epithelial structure beneath the nail, starting at the most proximal reach of the nail and finishing at the edge corresponding to the edge of the lunula.
- ***Lunula (half-moon):*** The convex margin of the matrix seen through the nail. It is more pale than adjacent nail bed. It is most commonly visible on the thumb and great toe. It may be concealed by the proximal nail fold.
- ***Nail bed (sterile matrix):*** The vascular bed upon which the nail rests extending from the lunula to the hyponychium. This is the major territory seen through the nail plate.
- ***Onychodermal band:*** The onychocorneal band represents the first barrier to penetration of materials to beneath the nail plate. Disruption of this barrier by disease or trauma precipitates a range of further events affecting the nail bed. The white appearance of the central band represents the transmission of light from the digit tip through the stratum corneum and up through the nail. If the digit is placed against a black surface, the band appears dark.
- ***Hyponychium*:** The cutaneous margin underlying free nail, bordered distally by the distal groove.
- ***Distal groove (limiting furrow)*:** A cutaneous ridge demarcating the border between subungual structures and the finger pulp.

Embryology: Morphogenesis

8–12 weeks: During the eighth week of pregnancy, individual digits are visible. The nail anlage, which is the epidermis covering the dorsal tip of the finger at 9 weeks, is the initial embryonic component of the nail unit. **13–14 weeks:** At 13 weeks, the finger's nail field is clearly formed, with a proximal nail fold supported by the matrix primordium. At 14 weeks, components originating from the lunula and more proximal matrix are visible when the nail plate emerges from behind the proximal nail fold.

17 weeks to birth: Around 17 weeks before delivery, the majority of the nail bed is covered by the nail plate. Beginning at 20 weeks, the finger and nail unit develop together, with the nail plate resting against the distal ridge. The nail plate reaches the distal groove at birth, but it gradually becoming less noticeable. The finger's volar surface may be curved by the nail. It could also show signs of koilonychia. This malformation, which is caused by the nail plate's thinness, is typical in infants. As one ages, it reverses [4].

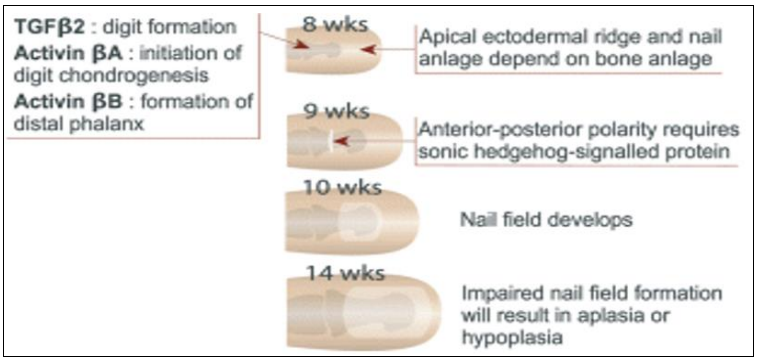

Fig 3: Development of the nail

Macro Anatomy

A longitudinal section of the perionychium, that is, the nail and its surrounding structures (including the hyponychium, nail matrix, and nail fold), shows the finger nail inserted into the nail fold (Fig. 4). The eponychium is the soft tissue located proximally on the dorsal surface of the nail extending from the dorsal finger skin. The fine filamentous material extending distally onto the nail from the eponychium is termed the nail vest. The white arc on the nail just distal to the eponychium is the lunula. The nail fold is made up of the dorsal roof and the ventral floor. The nail bed distal to the lunula is the sterile matrix. Where the sterile matrix intersects with the skin of the fingertip is the hyponychium. The indentations on the lateral sides of the nail, where the nail meets the skin of the finger, are known as the paronychium (Fig.5).

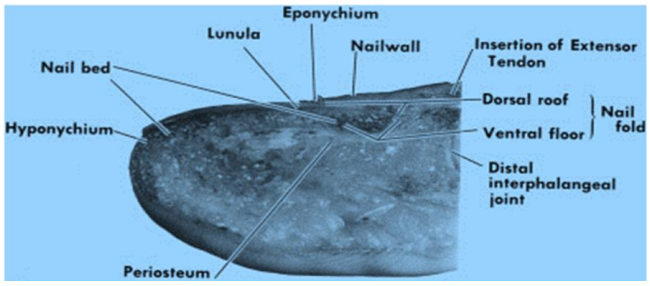

Fig 4: Anatomy of the perionychium

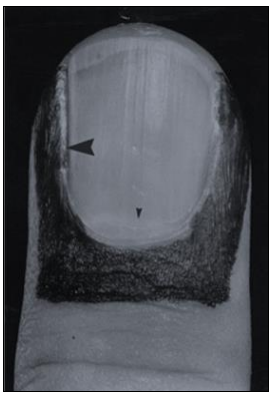

Fig 5: Large arrowhead - paronychium on the side & the small arrowhead- on the distal end of the lunula

Hyponychium

The hyponychium is a plug made of something that resembles keratin that is located where the nail bed and fingertip skin meet, below the distal border of the nail. The hyponychium is said to have more lymphocytes and polymorphonuclear leukocytes per unit volume than any other place in the body. This is said to explain why subungual infections are uncommon unless the person is involved in activities that result in prolonged immersion in solutions that damage or destroy the hyponychium and enable bacteria and fungi to grow under the nail. Additionally, the hyponychium may hypertrophy and extend under or above the nail, resulting in noticeable discomfort when the fingertip is moved or impacted.

Paronychium

He skins fold on both the lateral and medial sides of a nail, where the nail meets the finger, is called the paronychium this is where the finger's skin meets the nail bed. Although its anatomical purpose is unknown, the paronychium could aid in the nail's stability and adhesion to the fingertip. An over-lapping shingle pattern is formed by the furr along the paronychium's edge opposite the nail. Bacterial access often occurs at hangnails, which are caused by stripping up of the paronychium's margins. A paronychia is an infection under the nail's edge or along its fold. It is treated by irrigation, which may involve removing off the nail's lateral portion [5].

Nerve Supply

On the ventral radial and ulnar ends of the finger, the palmer digital nerve properly supplies the digital artery. The nail broke at the base of the fold, sending branches dorsally into the nail bed and branches to the pulp of the finger. In addition to the typical sense organs of the skin, the nail bed has many distinct structures called glomus bodies. Glomus bodies, which influence vasoconstriction and blood flow to the tips of the fingers, are made up of entwined balls of fine nerves and arteries. The nail bed and other regions on the tips of the fingers are where this glomus body most commonly appear.

Vascular Supply

A sizable branch of the right palmar digital artery enters the fingertip pulp at the level of the distal phalanx, and another branch branches parallel to the paronychium. Two branches, one distally under the distal third of the matrix and one proximally at the level of the lunula, cross the nail; the average diameter of these vessels is 0.32 mm. On the dorsum of the finger, the tiny veins of the nail bed combine to form bigger and bigger veins from distal to proximal [6].

Paronychia

A perionychium abscess or localized superficial infection is called a paronychia. Tender, erythematous, and swollen nail folds are its defining features. By creating a channel for the organism to enter, any breach of the seal between the

proximal nail fold and nail plate might result in infections of the eponychia area. Predisposing variables include trauma (such as manicures and pedicures), infections (including bacterial, viral, and fungal), structural deformities, and inflammatory illnesses (such as psoriasis). The wet nail crevice will allow organisms to enter, which will cause the region to get colonized. With a female to male ratio of three to one, paronychia is more frequent in women than in males. They typically afflict patients in vocations where they are regularly exposed to water for extended periods of time or manual labourers [6].

A. Depending upon the condition paronychia's are classified as:
1. Acute Paronychia
2. Chronic Paronychia

B. Classification also based on type of microorganisms:
1. **Bacterial:** commonly staphylococci
2. **Viral:** commonly Herpes simplex virus
3. **Fungal:** commonly Candida species

1. Acute Paronychia

➢ **Etiology and Risk Factors**

The majority of acute paronychia's arise from small trauma to the nail bed, which is frequently associated with nail biting, finger sucking, hanging nails, ingrown nails, manicures, dishwashing, or trauma of the puncture kind with or without a retained foreign substance. The damage causes the fingertip's natural defence against external germs to be compromised, which leads to perionychium inoculation. Anaerobic bacteria accounted for around 25% of paronychia cases in three investigations including 61 individuals, aerobic bacteria for 25%, and mixed aerobic and anaerobic bacteria for 50% of cases. Acute paronychia is most frequently caused by aerobic pathogens such as Staphylococcus aureus, group A B-haemolytic streptococci, gamma-haemolytic streptococci, Eikenella corrodens, and Klebsiella pneumoniae. Fusobacteria species, gram-positive anaerobic cocci, and Bacteroides species are common anaerobic bacteria that cause paronychia. Other isolated microbes that can trigger paronychia include Pseudomonas aeruginosa, Enterococcus faecalis, and Proteus species. Furthermore, nonbacterial pathogens including viruses like herpes simplex and yeast like Candida albicans have been found to be the causing agents. It is not always possible to pinpoint a particular trauma or trigger event in cases of acute paronychia [7].

➢ **Clinical presentation**

Fusobacteria species, gram-positive anaerobic cocci, and Bacteroides species are common anaerobic bacteria that cause paronychia. Other isolated microbes that can trigger paronychia include Pseudomonas aeruginosa, Enterococcus faecalis, and Proteus species. Furthermore, nonbacterial pathogens including viruses like herpes simplex and yeast like Candida albicans have been found to be the causing agents. It is not always possible to pinpoint a particular trauma or trigger event in cases of acute paronychia [7].

➢ **Diagnosis**

Based on the physical examination of the nail folds and a history of mild trauma, acute paronychia is diagnosed. When there is uncertainty regarding the existence or size of an abscess in the early stages of infection, the digital pressure test may be useful. In order to impart mild pressure to the distal volar aspect of the afflicted digit, the patient is asked to oppose their thumb and affected finger throughout the test. Blanching of the surrounding skin and a distinct separation of the abscess are the results of increased pressure within the nail fold, namely in the abscess cavity. A specimen should be taken from individuals who have a serious infection or abscess in order to determine the pathogen in question and rule out methicillin-resistant S. aureus (MRSA) infections [8].

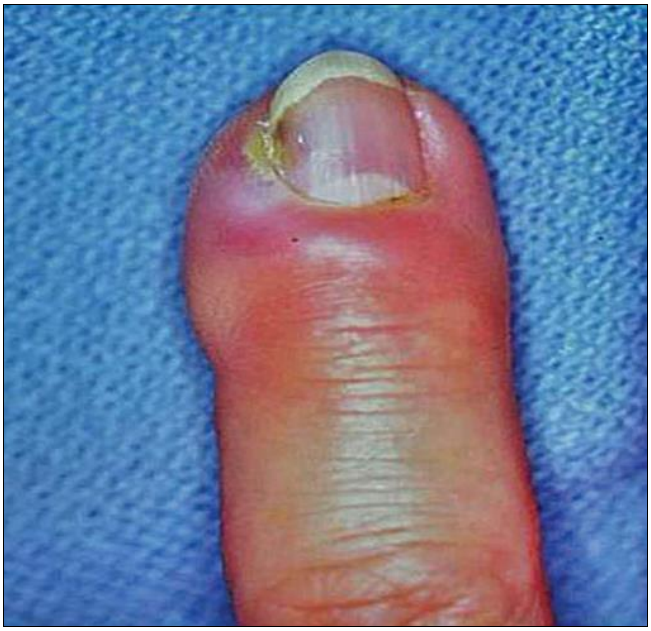

Fig 6: Acute Paronychia

2. Chronic Paronychia

➢ **Etiology and Risk Factors**

A swelling of the perionychium that lasts longer than six weeks is called chronic paronychia. There are several reasons for this inflammation, but it is frequently linked to recurrent exposure to environmental irritants. Fungal or bacterial infections colonize the affected area once the eponychium and nail vest undermine the barrier they produce. Many other types of irritants can cause exposure, and those who are frequently exposed to chemicals and/or moisture are more likely to develop chronic paronychia. People that work with food, such as cooks, bartenders, barbers, dishwashers, cooks, and nurses, are frequently shown to be at a higher risk of developing chronic paronychia. Patients with immunosuppressive disorders and diabetes mellitus are also more likely to develop chronic paronychia.

A prevalent pathogen linked to chronic paronychia is Candida albicans, which has been detected in cultures in 40% to 95% of patients. It's unknown exactly what part it plays in the onset and upkeep of chronic paronychia. By triggering a second, ongoing inflammatory response, the presence of Candida may indicate a secondary infection of the nail fold and aid in the formation of chronic paronychia. Stone and Mullins bathed their fingers in water until they were soaked and then injected either viable or nonviable Candida into the perionychium as part of a research on chronic paronychia. Both groups had inflammatory symptoms resembling chronic paronychia, indicating the pathogen's inflammatory action. Discovered that individuals

treated with topical corticosteroids alone saw more clinical improvement than those treated with systemic antifungals alone when it came to the therapy of chronic paronychia. Of the eighteen people who tested positive for infection at the beginning of the trial, only two were found to be cured upon eradication of Candida. The scientists came to the conclusion that rather than being a primary mycotic infection, persistent paronychia is an inflammatory disorder caused by Candida colonizing the nail fold in people with it [7].

➢ **Clinical presentation**

Erythema, soreness, and swelling, together with retraction of the proximal nail fold and lack of the surrounding cuticle, are comparable to those of acute paronychia. Pus can develop beneath the nail fold. Usually, the thumb, second, or third fingers of the dominant hand are the impacted fingernails. Nail loss and prominent transverse ridges like Beau's lines—which are caused by inflammation within the nail matrix—occur on the enlarged and discoloured nail plate. When chronic paronychia is diagnosed, it usually has been there for a minimum of six weeks. The illness often progresses slowly over time, with repeated, self-limiting bouts of severe aggravation.

➢ **Diagnosis**

Antibiotics are not normally necessary for treating paronychia infections; over-the-counter painkillers are usually adequate. Antibiotics are necessary, though, if cellulitis is present. Penicillin is effective against oral flora; however, it is ineffective against methicillin-resistant Staphylococcus aureus (MRSA). Sulfamethoxazole and trimethoprim (TMP/SMZ), clindamycin, or doxycycline may be used to treat anaerobic organisms including MRSA that are obtained in the community. Cephalexin could work as well. For inpatient care, a combination treatment with an intravenous drug that has antibacterial action against staphylococci is utilized. Fluconazole, itraconazole, and ketoconazole are examples of oral antifungals that are commonly used to treat chronic paronychial infections. In order to prevent problems, many of these medications need a lengthy course that includes laboratory test monitoring [8].

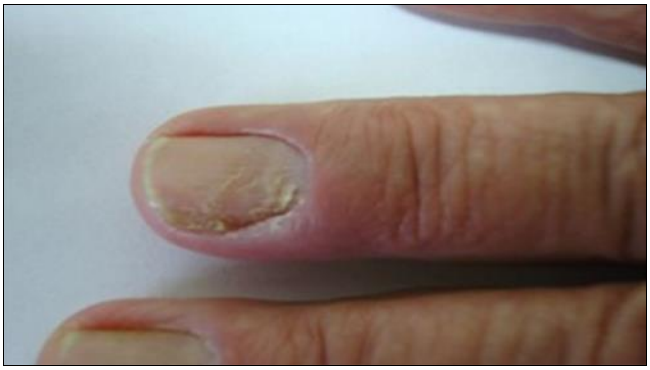

Fig 7: Chronic Paronychia

➢ **Causes of Paronychia**

- Cuts, broken skin or hangnails.
- Ingrown nails (this happens most often with ingrown toenails).
- Irritation from water or chemicals.
- Also cause by microbial infection like fungal, viral and bacterial.
- Trauma to the nailbed or cuticle area. Trauma can result from accidents, nail biting or frequent manicures or pedicures.
- Some medications can also cause paronychia. Some of these medications include retinoids, anti-cancer medications, HIV medications and some antibiotics.

➢ **Preventive Measures**

- The patient should be instructed to wear light cotton gloves to avoid the contact with moisture, irritants etc.
- Use heavy waterproof gloves when performing ‘‘wet work’’ or handling irritants.
- Cosmetic nail products of all kinds should be avoided.
- Pushing the cuticles back aggressively and commercial cuticle treatments can be harmful to patients with paronychia.
- Gloves should be worn in cold, windy weather to avoid drying and chapping which may leads to paronychia.
- Provide warm soak for the fingers if any irritation or discomfort occurs in the nail.

Pathophysiology

Current treatment available for paronychia are:

1. **Topical Therapy**
2. **Oral Therapy**
3. **Surgical avulsion**
4. **Laser treatment** [6]

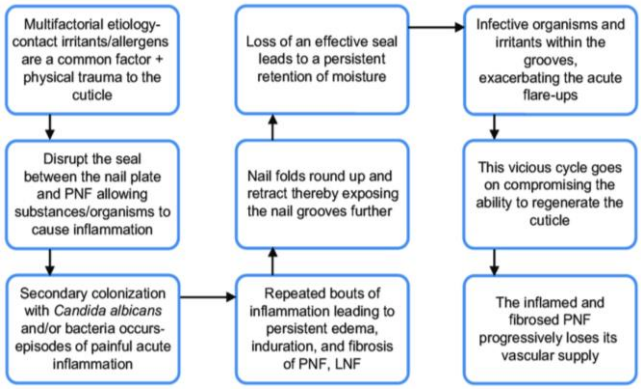

Fig 8: Pathophysiology of Paronychia

Polyherbal Cream

Creams are the semisolid dosage forms and intended for topical application to the skin, placed on the surface of eye, or used nasally, vaginally or rectally for therapeutic or protective action or cosmetic function. These preparations are used for the localized effects produced at the site of their application by drug penetration in to the underlying layer of skin or mucous membrane. These products are designed to deliver drug into the skin in treating dermal disorders, with the skin as the target organ.

Creams are semi-solid emulsions of oil and water. They are divided into two types: oil-in-water (O/W) creams which are composed of small droplets of oil dispersed in a continuous phase, and water-in-oil (W/O) creams which are composed of small droplets of water dispersed in a continuous oily phase. Oil-in-water creams are more comfortable and cosmetically acceptable as they are less greasy and more easily washed off using water. Water-in-oil creams are more difficult to handle but many drugs which are incorporated into creams are hydrophobic and will be released more readily from a water-in-oil cream than an oil-in-water cream. Water-in-oil creams are also more moisturizing as they provide an oily barrier which reduces water loss from

the stratum corneum, the outermost layer of the skin.

World Health Organization (WHO) as well our country has been promoting traditional medicine because they are less expensive, easily available and comprehensive, especially in developing countries.

It is also true that eight percent of the world's population relies on medicinal plants for their primary health care. Whole world including the developed country recognized the importance of traditional medicine and has treatment strategies, guidelines and standard for ethnos medicine.

The manifestations of skin diseases are many and many at times the treatment is to be continued for a long time. The need for a safe and effective herbal skin cream is to treat various skin diseases like wounds, acne vulgaris, cracks, psoriasis and various types of skin diseases.

Although various types of cream are considered for wound healing but these are still appearing to be limited in rate of tissue regeneration. Hence after a depth review regarding pathogenesis as well as different traditional and alternative therapy for wound healing.

The basic idea of skin care lies deep in the Rigveda, Yajurveda, Ayurveda, Unani and Homeopathic system of medicine. In this modern era, the knowledge and experience of usage of herbs are being blend with advanced cosmetic technology to develop a safe and effective product, which has wider range of people acceptability.

Wound healing

Wound is defined simply as the disruption of the cellular and anatomic continuity of a tissue. Wound may be produced by physical, chemical, thermal, microbial or immunological insult to the tissue. Wound healing is the process by which skin or other body tissue repairs itself after trauma. The process of wound healing consists of integrated cellular and biochemical events leading to reestablishment of structural and functional integrity with regain of strength of injured tissue. Clinically, one often encounters non-healing, under-healing or over healing. Therefore, the aim of treating a wound is to either shorten the time required for healing or to minimize the undesired consequences. Attention should be directed towards discovering an agent, which will accelerate wound healing either when it is progressing normally, or when it is suppressed by various agents like corticosteroids, anti-neoplastic, or non- steroidal anti-inflammatory agents. Medical treatment of wound includes administration of drugs either locally (topical) or systemically (oral or parenteral) in an attempt to aid wound repair. The topical agents used include antibiotics and antiseptics, wound healing promoters, aloe vera extract, Pergularia Daemia extract, Cissus quadrangularis extract, and Curcuma longa extract.

Classification of Creams

1. According to function, e.g. cleansing, foundation, massage, etc.
2. According to characteristics properties, e.g. cold creams, vanishing creams, etc.
3. According to the nature or type of emulsion:
   A. Make-up cream (o/w emulsion): **a.)** Vanishing creams**, b.)** Foundation creams.
   B. Cleansing cream, cleansing milk, Cleansing lotion (w/o emulsion).
   C. Winter cream (w/o emulsion), Cold cream or moisturizing creams.
   D. All-purpose cream and general creams.
   E. Night cream and massage creams.
   F. Skin protective cream [9].

Aim and Objective

Aim

To formulate a polyherbal cream using extracts of Pergularia Daemia, Cissus quadrangularis, and Curcuma longa for the treatment of paronychia and evaluate its efficacy and safety

Objectives

1. Conduct a thorough review of literature to identify the medicinal properties and traditional uses of Pergularia Daemia, Cissus quadrangularis, and Curcuma longa in treating inflammatory conditions and microbial infections, particularly those relevant to paronychia.
2. Optimize the formulation of the polyherbal cream by determining the most effective concentrations and ratios of the extracts from Pergularia Daemia, Cissus quadrangularis, and Curcuma longa, along with appropriate excipients for stability and skin compatibility.
3. Evaluate the physicochemical properties of the formulated polyherbal cream, including pH, viscosity, spread ability, and stability under various storage conditions.
4. Conduct compatibility and safety studies of the polyherbal cream to ensure its suitability for topical application, including skin irritation and sensitization tests.
5. Analyze the data obtained from formulation and evaluation studies to optimize the polyherbal cream formulation for maximum efficacy and safety while minimizing potential side effects.

A. Plants Profile

1. Cissus Quadrangularis

Cissus quadrangularis is commonly known as (Hadjod) is a perennial plant native to the Indian subcontinent and parts of Southeast Asia. It belongs to the grape family *Vitaceae.*

Biological Source: Whole dried plant of *Cissus quadrangularis L.*

Geographical Source: Cissus quadrangularis is native to the Indian subcontinent, particularly found in regions such as India, Sri Lanka, and Bangladesh. It also grows in other parts of Southeast Asia, including Thailand and Indonesia. Additionally, it has been introduced and cultivated in various other tropical and subtropical regions around the world due to its medicinal properties and ornamental value. It is native to India, Bangladesh and Sri Lanka. It is also found in Africa and Southeast Asia. It is being imported to Brazil and the southern United States.

Morphology: Cissus quadrangularis reaches a height of 1.5 m and has quadrangular-sectioned branches with internodes of about 8 to 10 cm long and 1.2 to 1.5 cm wide. Along each angle is a leathery edge. The Toothed trilobe leaves 2 to 5 cm wide appear at the nodes. Each has a tendril emerging from the opposite side of the node. Racemes of small white, yellowish, or greenish flowers, globular berries are red when ripe [10].

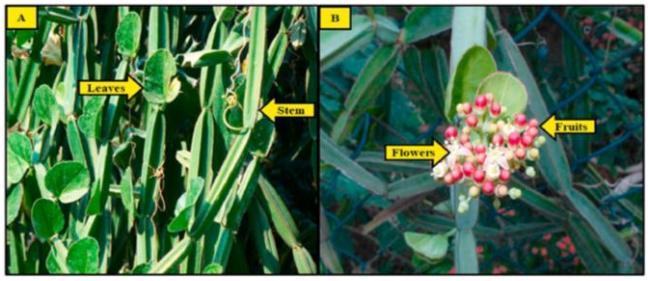

Fig 9: Photograph of CQL (A) leaves and stem; (B) flowers and fruits

➢ **Taxonomy of *Cissus quadrangularis***

Table 2: Taxonomy of *Cissus quadrangularis*

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Vitales
Family	Vitaceae
Genus	Cissus
Species	Quadrangularis

➢ **Vernacular names**

English: Edible stemmed vine, Adamant creeper, Bone setter
Hindi: Hadjod, Hadjora, Hadsarihari, Harsankari, Kandvel
Bengali: Har, Harbhanga, Hasjora, Horjora
Gujarati: Chodhari, Hadsand, Hadsankal, Vedhari
Kanada: Mangarahalli
Malayalam: Cannalamparanta, Peranta
Marathi: Horjora, Harsankar, Kandavel, Nalllar
Tamil: Piranti, Vajjravalli
Telugu: Nalleru, Nelleratiga, Vajravalli
Oriya: Hadavhanga
Urdu: Harjora, Hadsankal [10]

2. Pergularia Daemia

Pergularia Daemia is commonly known as Uttran. Is a plant species belonging to the family *Asclepiadaceae*. It is native to tropical and subtropical regions, particularly found in Africa, Asia, and Australia.
Biological Source: Dried parts of Leaves, Stems & Roots of *Pergularia Daemia*.
Geographical Source: A widely distributed in the tropical and sub-tropical area. In India it is very commonly found in hedges through cut most of center to an altitude about 1000m in Himalayas and 900m in Southern India.
Morphology: A slender, hispid, fetid- smelling perennial climber. Leaves opposite, membranous, 3-9 cm long and about as wide, broadly ovate, orbicular or deeply cordate, acute or short acuminate at apex, ubescent beneath, petioles 2-9 cm long. Flowers greenish-yellow or dull white tinged with purple, borne in axillary, long-peduncled, drooping clusters. Fruits (follicles) lanceolate, long-pointed, about 5 cm long, covered with soft spines and seeds are pubescent, broadly ovate. Flowering may occur each year between August and January in central India, with fruits maturing from October to February. In central Indian deciduous forests, the stems typically die down in February and reappear with the onset of the rainy season.

Leaf &Flowers Fruit Arial Part

Fig 10: Various parts of Pergularia Daemia

1. Taxonomy of *Pergularia Daemia*

Table 3: Taxonomy of *Pergularia Daemia*

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	Pergularia
Species	P. Daemia (Forsk) Chiv.

➢ **Vernacular names**

Daemia (Forsk) Chiv or P. extensa N.E. Br or Daemia extensa R. Br
Bengali: Chagulbanti, Changulbati
Guajarati: Amaradudheli, Chamardudhel
Hindi: Utranajutuka, Utran, Dudhi, Dudhibel
Kannada: Haalu koratige, Hala koratige
Malayalam: Veliparatti, Veliparuti
Marathi: Utaranavel, Uturhi
Oriya: Juktiruhi, Uttruri, Uturdi
Sanskrit: Uttaravaruni, Kurutakah, Yugaphala,
Tamil: Beliparti, Nandamani, Uthamani, Veliparuthi [12].

3. Curcuma longa L

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial of the ginger family, *Zingiberaceae*. It is native to southern Asia, requiring temperatures between 20 and 30 °C (68 and 86 °F) and a considerable amount of annual rainfall to thrive.
Biological Source: Dried *Curcuma longa* is the source of the spice turmeric. The underground stems, or rhizomes, of the turmeric plant are the part that is used for its culinary and medicinal purposes.
Geographical Source: Grows to a height of three to five feet and is cultivated extensively in Asia, India, China, and other countries with a tropical climate. It is commonly found in Cambodia, China, India, Nepal, Indonesia, Madagascar, Malaysia, Philippines and Viet Nam. India scenario: It is commonly found in West Bengal, Tamil Nadu, and Maharashtra and also in Madras. The turmeric plant needs temperatures between 20°C and 30°C and a considerable amount of annual rainfall to thrive.
Morphology: Turmeric, is a perennial, erect and leafy plant with very large, lily like leave up to 1.2 m long. It has oblong, pointed leaves and funnel-shaped yellow flowers. The rhizome, the portion of the plant used medicinally, is usually boiled, cleaned, and dried, yielding a yellow powder. Turmeric is a perennial herbaceous plant that reaches up to 1 m (3 ft 3 in) tall. Highly branched, yellow to orange, cylindrical, aromatic rhizomes are found. The leaves

are alternate and arranged in two rows. They are divided into leaf sheath, petiole, and leaf blade. From the leaf sheaths, a false stem is formed. The petiole is 50 to 115 cm (20 to 45 in) long. The simple leaf blades are usually 76 to 115 cm (30 to 45 in) long and rarely up to 230 cm (91 in). They have a width of 38 to 45 cm (15 to 18 in) and are oblong to elliptic, narrowing at the tip.

Fig 11: Turmeric

➢ **Taxonomy of *Curcuma longa L***

Table 4: Taxonomy of *Curcuma longa L*

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	spermatophyta
Division	Magnoliophyta
Class	Lilliopsida
Subclass	Zingiberidae
Order	Zingiberales
Family	Zingiberaceae
Genus	Curcuma L.
Species	Curcuma longa L.

➢ **Vernacular names**
Sanskrit: Ameshta
English: Indian saffron
Hindi: Haldi
Bengali: Halud
Assamese: Kordoi/ rohdoi
Gujarati: Halad, Haldar
Marathi: Halad
Telugu: Haridra
Tamil: Ameshta
Malayalam: Manjal
Sinhala: Kaha
French: Curcuma
Indonesian: Kunyit
Malay: Kunyit basah [14].

4. Aloe Vera
Aloe Vera is *Aloe barbadensis mill* operator. It has a place to *Asphodelaceae* (*Liliaceae*) family.
Biological Source: It is characterized by its thick, fleshy leaves that contain a gel-like substance are used in cosmetics, skincare products, and alternative medicine.
Geographical Source: Aloe vera are innate to East and South Africa, however have been brought into the West Indies and into topical countries, and will indeed flourish within the countries skirting on the Mediterranena. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, UK, Himachal Pradesh, and Tamil Nadu, It is financially created in Aruba, Bonaire, Haiti, India, South Africa, the Joined together of America and Venezula.

Morphology: Aloe vera is a stemless or very short-stemmed plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower being pendulous, with a yellow tubular corolla 2–3 cm (0.8– 1.2 in) long. Like other Aloe species, Aloe vera forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil.

Fig 12: *Aloe Vera*

➢ **Taxonomy of *Aloe Vera***

Table 5: Taxonomy of *Aloe Vera*

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	spermatophyta
Division	Magnoliophyta
Class	Lilliopsida
Subclass	Liliidae
Order	Asparagales
Family	Asphodelaceae
Genus	Aloe
Species	Aloe vera

➢ **Vernacular names**
English: Aloe vera
Hindi: Ghritkumari
Spanish: Sábila
Portuguese: Babosa
Chinese: Lúhuì
Arabic: Sabbar
Tamil: Kattazhai
Telugu: Kumari chettu
Malay: Lidah Buaya
French: Aloès vrai [15].

B. Drug Profile
I. Cissus Quadrangularis
➢ **Chemical Constituent**
Phytochemical studies on methanol extract revealed the presence of triterpenes including α- and β- amyrins, β-sitosterol, ketosteroids, phenols, tannins, carotene and vitamin C. Seven alicyclic lipids constituents have also been

reported from Cissus quadrangularis. unsymmetric tetracyclic triterpenoids such as d-amyrin, onocer-7-ene-3a, 21b-diol, d-amyrone and 3,3',4,4'-tetra hydroxy biphenyl, 3,3',4,4'- tetrahydroxy biphenyl have been isolated from plant and were quantitatively determined by HPTLC and HPLC methods in samples collected from five different geographic zones of India. Several other constituents such as flavonoids quercetin and kaempferol, and stilbene derivatives, quadrangularins A, B, C and many others e.g. resveratrol, piceatanon, pallidol, Parthenocissus and phytosterols have been isolated from plant [10].

1. **Steroids:** β-sitosterol
- Chemical Formula: $C_{29}H_{50}O$
- Molecular Weight: 414.71 g/mol.

✓ Anti-microbial and antibacterial activity.
✓ Analgesic and anti- inflammatory activity.

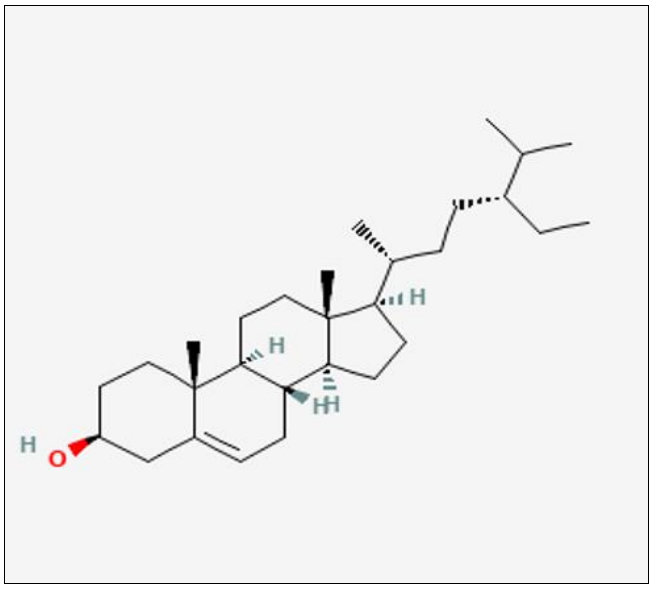

Fig 13: Structure of β-sitosterol

2. **Flavonoid:** Kaempferol
- Chemical Formula: $C_{15}H_{10}O_6$
- Molecular Weight: 286.23 g/mol
  - ✓ Kaempferol strong antibacterial potential against Staphylococcus aureus or Streptococcus species.

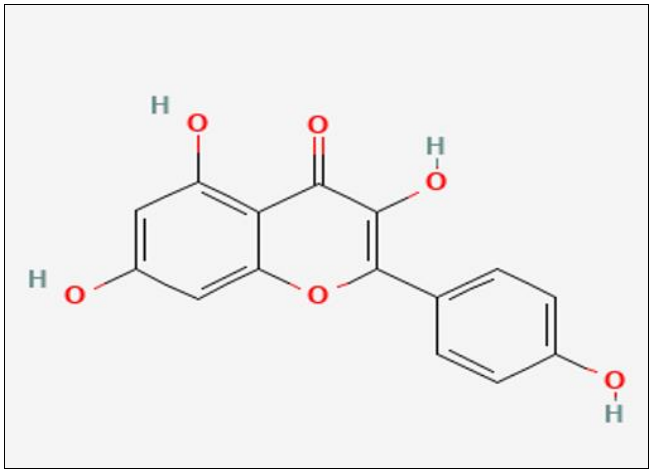

Fig 14: Structure of Kaempferol

3. **Carotenoids:** β Carotene
- Chemical Formula: $C_{40}H_{56}$
- Molecular Weight: 536.873 g/mol
  - ✓ β Carotene exhibit strong antioxidant activity

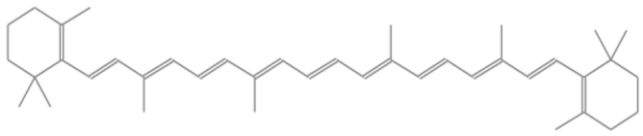

Fig 15: Structure of β Carotene

➢ **Pharmacological uses**

1. **Anti-microbial and antibacterial activity:** Methanol extract (90%) of stems possesses antibacterial activity against S. aureus, E. coli, and P. aeruginosa and mutagenicity against Salmonella microsome. Antimicrobial activity has also been reported from stem and root extract. The alcoholic extract of aerial part was found to possess antiprotozoal activity. Alcoholic extract of the stem showed activity against E. coli. Methanol extract of whole plant was screened for *in vitro* ant plasmodial activity. The presence of steroids and flavonoids Observed antiviral action may be due to immunomodulation by CQL. Kaempefrol as a flavonoid already exhibited its strong antibacterial potential against Staphylococcus aureus or Streptococcus species.
2. **Antioxidant activity:** Methanol extract of Cissus quadrangularis exhibit strong antioxidant activity *in vitro* and *in vivo* systems mainly due to the presence of β-carotene.
3. **Analgesic and anti-inflammatory activity:** Anti-inflammatory activity is due to flavonoids especially luteolin and by β-sitosterol. β-sitosterol present in methanol extract has ability to reduce the enzymes MPO indicating a reduction of neutrophils influx in the inflamed tissue. Methanol extract (90%) of stems possess anti-inflammatory activity against COX-2. The phytosterols (β-sitosterol and β-sitosterol glycoside), terpenoids, phenolic compounds like resveratrol, quercetin, quercitrin and kaempferol present in the CQL were considered to produce analgesic activity [10, 11].

II. *Pergularia Daemia:*

➢ **Chemical Constituent**

Reported to contain β-sitosterol, lupeol, lupeol acetate, α, β-amyrin and its acetate in entire plant and root. Various cardenolide such as calotoxin, calotropagenin, dihydro calotropagenin, calotropin and uscharidin in seed, while coroglaucigenin, corotoxigenin, uscharidin and uzarigenin in stem. Uscharidindaemia extensa polypeptide, daemia extensa glucoside, Inorganic salts such as Kcl and KNO_3 in entire plant. Hyperoside (flavanol) in dried stem, while flavonoids and saponins in fresh shoots and flowers.

1. **Terpenes and Terpenoids:** α-amyrin
- Chemical Formula: $C_{30}H_{50}O$
- Molecular Weight: 426.71 g/mol
  - ✓ For anti-inflammatory activity
  - ✓ Anti-oxidant activity

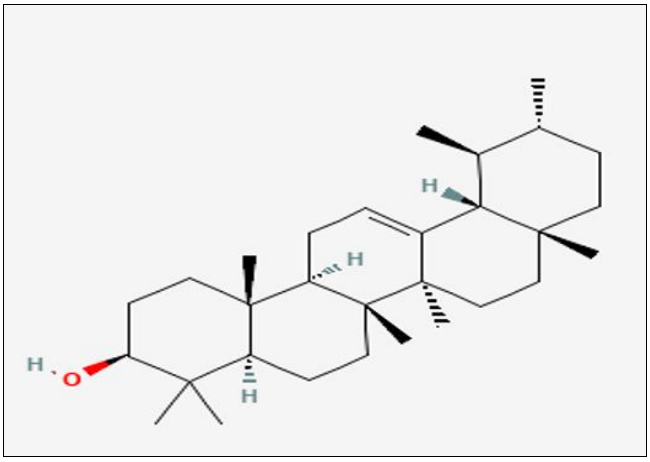

Fig 16: Structure of α-amyrin

2. **Terpenes and Terpenoids:** *β-amyrin*
- Chemical Formula: $C_{30}H_{50}O$
- Molecular Weight: 426.71 g/mol
  - ✓ Anti-fungal activity
  - ✓ Anti-inflammatory Activity

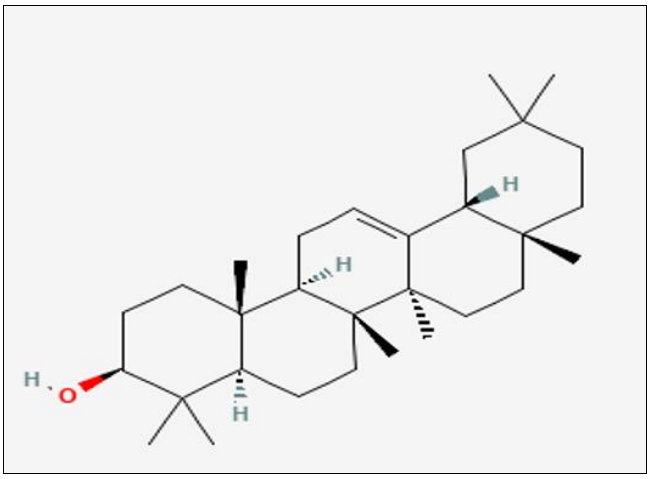

Fig 17: Structure of β –amyrin

3. **Steroids:** - β-sitosterol
- Chemical Formula: $C_{29}H_{50}O$
- Molecular Weight: 414.71 g/mol.
  - ✓ Anti-microbial and antibacterial activity
  - ✓ Analgesic and anti-inflammatory activity

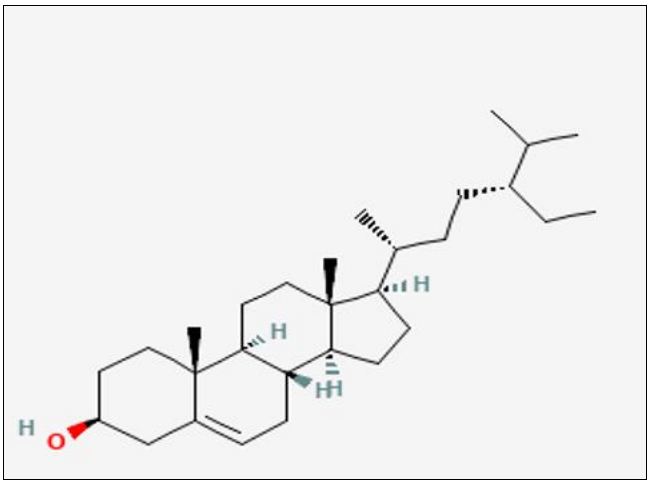

Fig 13: Structure of β-sitosterol

4. **Tri-Terpenoid:** Lupeol
- Chemical Formula: $C_{30}H_{50}O$
- Molecular Weight: 426.72 g/mol
  - ✓ Anti-inflammatory Activity
  - ✓ Anti-microbial and Anti-oxidant activity

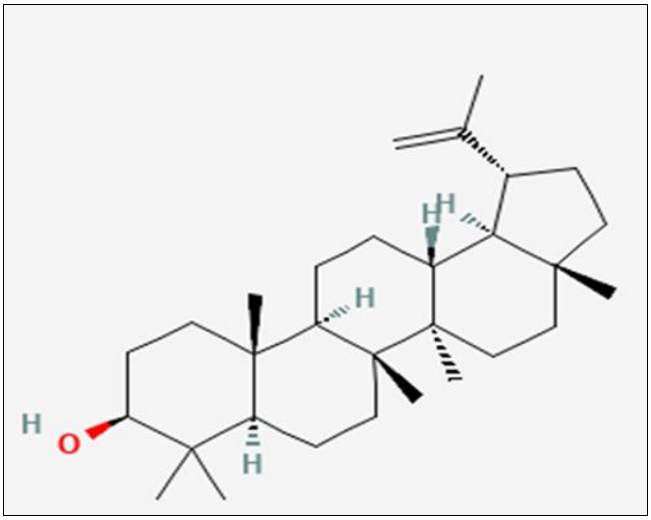

Fig 18: Structure of Lupeol

➢ **Pharmacological uses**

1. **Anti-inflammatory, Analgesic and Antipyretic activity:** The anti-inflammatory activity of Pergularia daemia extract could be attributed due to the presence of steroids. Analgesic effect of aqueous and ethanol extract of Pergularia daemia. Antipyretic activity was also reported from the aerial parts of Pergularia daemia extract. The presence of rich flavonoids and glycosides in P. daemia might be a major reason for exhibiting anti-inflammatory and analgesic activity
2. **Antibacterial activity:** The promising antibacterial activity was observed in ethyl acetate and ethanol extracts of Pergularia daemia which showed significant antibacterial activity against S. aureus, P. aeruginosa, A. hydrophila, E. coli and S. typhi [12, 13].

III. Curcuma longa L

➢ **Chemical Constituents**

Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). The essential oil (5.8%) obtained by steam distillation of rhizomes has a-phellandrene (1%), sabinene (0.6%), cineol (1%), borneol (0.5%), zingiberene (25%) and Sesquiterpenes (53%)5. Curcumin (diferuloylmethane) (3–4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%)6. Demethoxy and bisdemethoxy derivatives of curcumin have also been isolated7 (Figure 1). Curcumin was first isolated8 in 1815 and its chemical structure was determined by Roughley and Whiting9 in 1973. It has a melting point at 176–177°C; forms a reddish-brown salt with alkali and is soluble in ethanol, alkali, ketone, acetic acid and chloroform.

1. **Curcumin**
- Chemical Formula: $C_{21}H_{20}O_6$
- Molecular Weight: 368.38 g/mol
  - ✓ Anti-inflammatory activity

- ✓ Antimicrobial Activity
- ✓ Antifungal Activity
- ✓ Wound healing

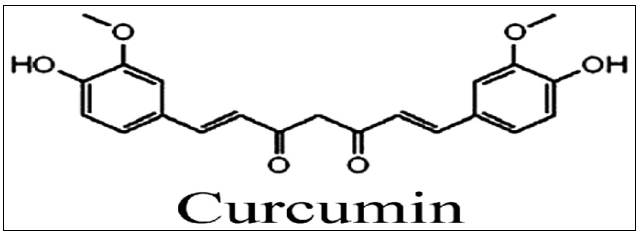

Fig 19: Structure of Curcumin

➢ **Pharmacological uses**

1. **Anti-inflammatory activity:** Curcumin is a potent anti-inflammatory with specific lipoxygenase- and COX-2-inhibiting properties. Animal, *in vitro*, and *in vivo* studies demonstrate turmeric's effectiveness at decreasing both acute and chronic inflammation.
2. **Antimicrobial Activity:** Turmeric extract and the essential oil of Curcuma longa inhibit the growth of a variety of bacteria, parasites, and pathogenic fungi.
3. **Antifungal Activity:** Ether and chloroform extracts and oil of C. longa have antifungal effects. Crude ethanol extract also possesses antifungal activity [16].

Pharmaceutical Excipients

1. Bees wax

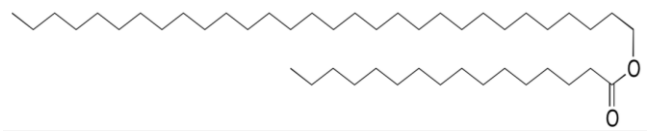

Fig 20: Structure of beeswax

➢ **Properties of bee's wax**

Table 6: Properties of bee's wax

Form	Solid
Colour	Yellow to dark brown
Oduor	Characteristic
Melting point	62-64°C
Solubility	Insoluble in water

➢ **Uses of bee's wax**

1. Beeswax carries antiviral, anti-inflammatory, and antibacterial properties that are essential in fighting chapped skin and bacterial infections that tend to affect us most in the dry, winter months. It forms a protective wall by sealing in moisture in our skin without smothering and clogging up the pores.

2. Liquid paraffin

➢ **Properties of liquid paraffin**

Table 7: Properties of liquid paraffin

Form	Liquid
Colour	Colorless
Oduor	Odorless
Melting point	Undetermined
Boiling point	degrees C>300

➢ **Uses of liquid paraffin**

1. Liquid paraffin is used as a barrier cream by providing a layer of oil on the surface of the skin to prevent water evaporating from the skin surface.
2. It is an emollient, sometimes known as skin lubricant.
3. It is used to soothe, smooth and hydrate the skin.

3. Methyl paraben

➢ **Properties of methyl paraben**

Table 8: Properties of methyl paraben

Form	Crystal
Colour	Colorless
Odour	Odorless
Melting point	125 - 128°C
Boiling point	270 - 280°C

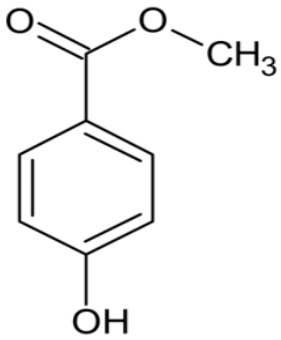

Fig 21: Structure of Methyl Paraben

➢ **Uses of methyl paraben**

1. Methyl paraben is an anti-fungal agent often used in a variety of cosmetics and personal-care products.
2. It is also used as a food preservative.

4. Borax

➢ **Properties of Borax**

Table 9: Properties of Borax

Form	white, crystalline
Colour	white
Odour	Odorless
Melting point	743°C
Boiling point	1575°C

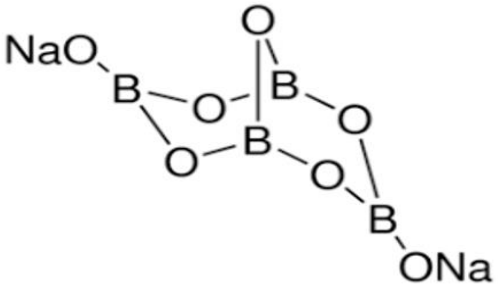

Fig 22: Structure of Borax

➢ **Uses of Borax**

1. Borax can act as an emulsifying agent, helping to stabilize the mixture of water and oils in the cream.

2. By adjusting the concentration of borax in the formulation, you can control the thickness of the cream to achieve the desired texture.
3. Borax can also act as a preservative [17].

- **Phytochemicals Analysis**

❖ **Infrared (IR) spectroscopy**

1. Cissus quadrangularis L.

Among the potent analytical methods that provide the potential for chemical identification is infrared spectroscopy. The method is based on the straightforward observation that certain chemical substances exhibit selective infrared absorption. The molecules shake when infrared energy is absorbed, creating an absorption spectrum. It's a great technique for qualitative investigation since, aside from optical isomers, the compound's spectrum is distinct. It works best for identifying coarse structural features and purity. This technique is helpful in the fields of forensic chemistry, industrial examination of rival products, and natural products. The *Cissus quadrangularis L*. stem methanol extract and its fractions' infrared spectra were scanned on an FT-IR PerkinElmer Spectrum throughout a frequency range of 4000-450cm^{-1}.

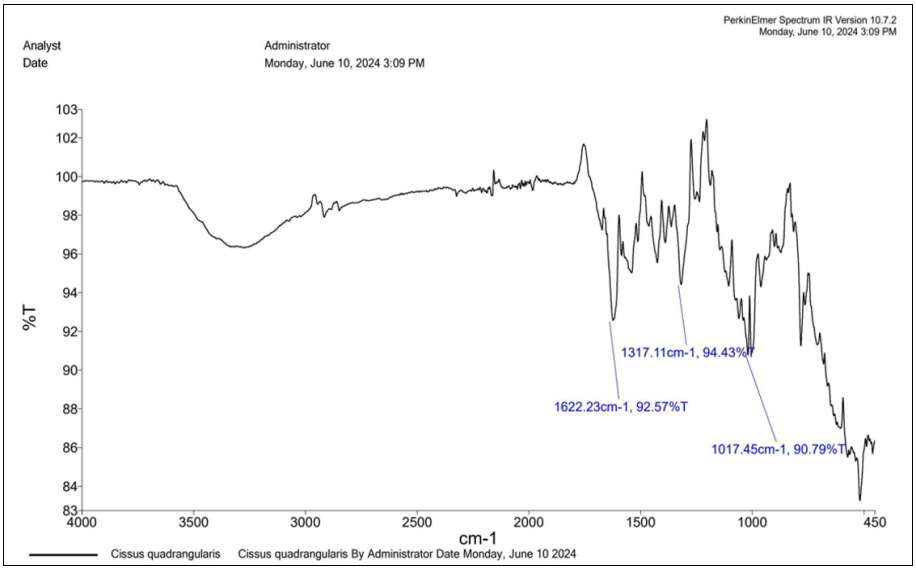

Fig 23: IR spectra of methanol extract of Cissus quadrangularis L

Table 10: Interpretation of Methanol Extract of C. quadrangularis

Compound Type	Functional Group	Wavenumber (cm^{-1})	Type of Vibration
Flavonoids	O-H	3200-3600	Stretching (broad)
	C=O	1650-1750	Stretching (sharp)
	C=C (Aromatic)	1500-1600	Stretching
	C-O	1000-1300	Stretching
Steroids	O-H	3200-3600	Stretching (broad)
	C=O	1700-1750	Stretching (sharp)
	C-H	2850-2960	Stretching
	C=C	1600-1680	Stretching
Carotenoids	C-H	2850-2960	Stretching
	C=C (Conjugated)	1500-1650	Stretching (strong)
	C-H	1350-1450	Bending

➢ **Results of IR spectroscopy**

IR spectra of ME and its fractions are shown in Fig. 23 the mid infrared, approximately 4000–450 cm^{-1} (83–103 μm) was used to study the fundamental vibrations and associated rotational vibrational spectrum. Interpretation of Methanol Extract are given in Table 10.

Using these characteristic IR absorptions, you can identify the presence of flavonoids, steroids, and carotenoids in an IR spectrum by comparing the observed peaks to the standard reference values listed above.

2. Pergularia daemia

Among the potent analytical methods that provide the potential for chemical identification is infrared spectroscopy. The method is based on the straightforward observation that certain chemical substances exhibit selective infrared absorption. The molecules shake when infrared energy is absorbed, creating an absorption spectrum. It's a great technique for qualitative investigation since, aside from optical isomers, the compound's spectrum is distinct. It works best for identifying coarse structural features and purity. This technique is helpful in the fields of forensic chemistry, industrial examination of rival products, and natural products. The *Pergularia daemia*. Stem methanol extract and its fractions' infrared spectra were scanned on an FT-IR PerkinElmer Spectrum throughout a frequency range of 4000-450cm^{-1}.

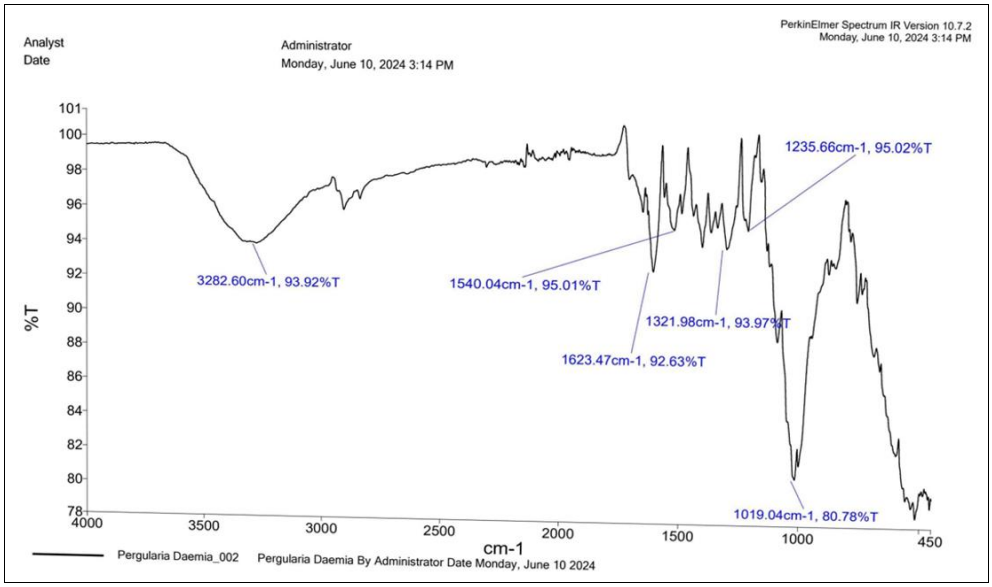

Fig 24: IR spectra of methanol extract of *Pergularia daemia*

Table 11: Interpretation of Methanol Extract of *Pergularia daemia*

Compound Type	Functional Group	Wavenumber (cm^{-1})	Type of Vibration
Terpenes	C-H (Alkyl)	2850-2960	Stretching
	O-H (if present)	3200-3600	Stretching (broad)
	C=O (if present)	1650-1750	Stretching (sharp)
	C=C	1600-1680	Stretching
Terpenoids	C-H (Alkyl)	2850-2960	Stretching
	O-H (if present)	3200-3600	Stretching (broad)
	C=O (if present)	1650-1750	Stretching (sharp)
	C=C	1600-1680	Stretching
Steroids	C-H (Alkyl)	2850-2960	Stretching
	O-H (if present)	3200-3600	Stretching (broad)
	C=O (if present)	1700-1750	Stretching (sharp)
	C=C	1600-1680	Stretching
Triterpenoids	C-H (Alkyl)	2850-2960	Stretching
	O-H (if present)	3200-3600	Stretching (broad)
	C=O (if present)	1650-1750	Stretching (sharp)
	C=C	1600-1680	Stretching

Results of IR spectroscopy

IR spectra of ME and its fractions are shown in Fig. 24 the mid infrared, approximately 4000–450 cm^{-1} (83–103 µm) was used to study the fundamental vibrations and associated rotational vibrational spectrum. Interpretation of Methanol Extract are given in Table 11.

By comparing these characteristic IR absorptions with the observed peaks in the IR spectrum of *Pergularia daemia*, you can identify the presence of terpenes, terpenoids, steroids, and triterpenoids. This approach helps to elucidate the chemical composition of the plant and its potential bioactive compounds.

3. Curcuma longa

Among the potent analytical methods that provide the potential for chemical identification is infrared spectroscopy. The method is based on the straightforward observation that certain chemical substances exhibit selective infrared absorption. The molecules shake when infrared energy is absorbed, creating an absorption spectrum. It's a great technique for qualitative investigation since, aside from optical isomers, the compound's spectrum is distinct. It works best for identifying coarse structural features and purity. This technique is helpful in the fields of forensic chemistry, industrial examination of rival products, and natural products. The *Curcuma longa*. Stem methanol extract and its fractions infrared spectra were scanned on an FT-IR PerkinElmer Spectrum throughout a frequency range of 4000-450cm^{-1}.

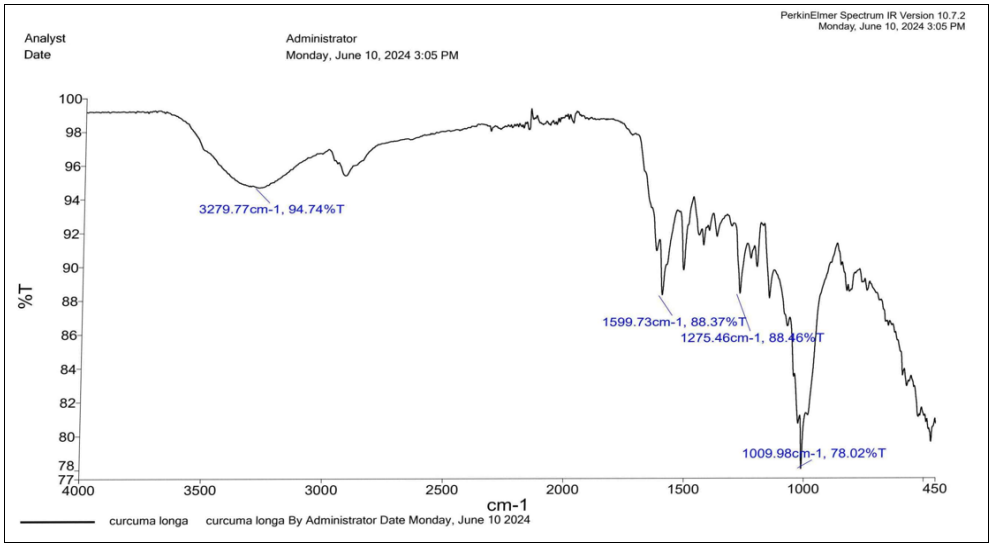

Fig 25: IR spectra of methanol extract of Curcuma Longa

➢ **Result of IR spectroscopy**

IR spectra of ME and its fractions are shown in Fig. 25 the mid infrared, approximately 4000–450 cm^{-1} (83–103 μm) was used to study the fundamental vibrations and associated rotational vibrational spectrum. Interpretation of Methanol Extract are given in Table 12.

Table 12: Interpretation of Methanol Extract of *Curcuma longa*

Compound Type	Functional Group	Wavenumber (cm^{-1})	Type of Vibration
Curcumin	O-H (phenolic)	3200-3500	Stretching (broad)
	C-H (alkyl)	2850-2960	Stretching
	C=O (carbonyl)	1625-1650	Stretching (sharp)
	C=C (aromatic and conjugated)	1500-1600	Stretching
	C-O (alkoxy, phenolic)	1200-1300	Stretching

By comparing these characteristic IR absorptions with the observed peaks in the IR spectrum of ***Curcuma longa***, you can confirm the presence of curcumin and gain insights into the chemical structure and functional groups of this bioactive compound.

Material and Method

Material

Apparatus: Beaker, Test tubes, test tube holder, Glass rod, Iodine flask, Funnel, Conical flask, Measuring cylinder, pipette, Water Bath, Spatula, Whatmann No. 1 filter paper. Tripod Stand, Wire Gauze. Etc.

Chemicals: Ethyl Acetate, Aloe vera gel, Beeswax, Liquid Paraffin, Borax, Methyl Paraben, Orange Oil, H_2SO_4, Boric acid, Hcl, $Fecl_3$, $Sbcl_3$, $CHcl_3$, Acetic anhydride,NaOH, Chloroform,Copper Acetate, Pergularia daemia Extract, Cissus quadrangularis Extract, Curcumin Extract. Etc.

Instruments': Weighing balance, Heating mantle, PH meter etc.

Method

1. Extraction

A. Extraction of Curcumin: By using Maceration technique

1. Grounded Turmeric powder collected from market.
2. About 15 g of finely ground turmeric powder was dissolved in 100 ml of 70% alcohol (Ethyl Acetate).
3. Preparation of Alcoholic preparation in iodine flask for Maceration process.
4. The preparation was left undisturbed for 48 hours.
5. After 48hr. Filtrate it.
6. The crude ethanolic extract was formed.
7. Used to further formulation [18].

Fig 26: Extraction of Curcumin

B. Extraction of Cissus quadrangularis: By using Maceration technique

1. Cissus quadrangularis plant was collected from garden.
2. Whole nodes are cleaned and dried by sun drying method.
3. Prepared a powder by using grinder.
4. Weight about 15 g powder was dissolved in 100 ml of 70% methanol. And transferred it in iodine flask.
5. The preparation was left at room temperature overnight.
6. The maceration was repeated three times and filtered.
7. The crude methanolic extract was evaporated.
8. Residue was used to further formulation [19].

Fig 27: Extraction of Cissus quadrangularis

C. Extraction of Pergularia daemia: By using Maceration technique

1. Pergularia daemia plant was collected from garden.
2. Whole aerial plant part is cleaned and dried by sun drying method.
3. Prepared a powder by using grinder.
4. Weight about 10 g powder was dissolved in 100 ml of 70% ethanol. And transferred it in iodine flask.
5. The preparation was left undisturbed for 72 hours.
6. After 72 hr. filtered through Whatmann No. 1 filter paper.
7. The crude ethanolic extract was evaporated.
8. Residue was used to further formulation [20].

Fig 28

2. Identifications Tests for Bioactive Compounds:

A. Curcumin

1. Curcumin Extract + H_2SO_4 ⟶ Crimson Colour.
2. Curcumin Extract + Boric Acid ⟶ Reddish Brown Colour.
3. Curcumin Extract + Hcl ⟶ Pink Colour.
4. Curcumin Extract + $Fecl_3$ ⟶ Green Colour [21].

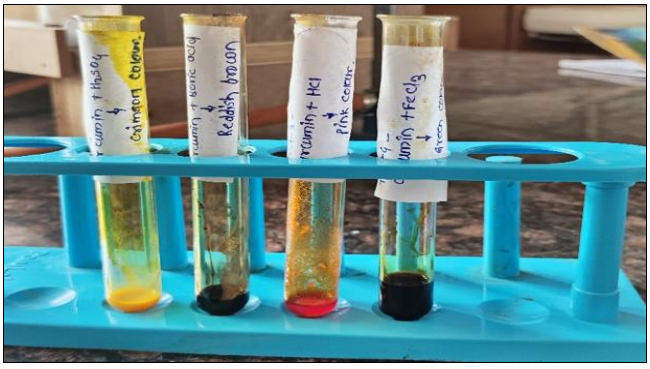

Fig 29: Identification test of Curcumin

B. *Cissus quadrangularis*

1. Carotenoids

i. **Carr-Prize Test:** Alcoholic Extract of Drug + $Sbcl_3$ or $CHcl_3$ ⟶ Blue colour.

2. Steroids

i. **Liebermann-Burchard Test:** Alcoholic Extract of Drug + Acetic anhydride, Boil & cool it. + Conc. H_2SO_4 in test tube ⟶ Brown ring formed at the junction of two layers and upper layer turns green.

ii. **Salkowski Test:** Alcoholic Extract of Drug + Conc. H_2SO_4 ⟶ Red Colour in Lower Layer.

3. Flavonoids

i. **Shinoda Test:** Alcoholic extract of drug + Few Magnesium turnings + Conc. Hcl dropwise add. ⟶ Crimson red colour occurs occasionally blue colour appear after few min.

ii. **Alkaline Reagent Test:** Alcoholic extract of drug + Few Drop NaOH solution ⟶ Intense yellow colour form which turns to colourless on addition of dilute acid.

iii. **Sulphuric acid:** Alcoholic extract of drug + Conc. H_2SO_4 ⟶ Red colour occurs [22].

C. *Pergularia Daemia*

1. Terpenoids

i. **Salkowski test:** Alcoholic extract of drug + Add few drops of Chloroform + Carefully added Conc. H_2SO_4 to form layer ⟶ Reddish Brown colour at junction of two layers.

ii. **Copper Acetate test:** Extract dissolved in water + added few drops of copper acetate ⟶ Formed emerald green colour.

2. Steroids

i. **Liebermann-Burchard Test:** Alcoholic Extract of Drug + Acetic anhydride, Boil & cool it. + Conc. H_2SO_4 in test tube ⟶ Brown ring formed at the junction of two layers and upper layer turns green.

ii. **Salkowski Test:** Alcoholic Extract of Drug + Conc. H_2SO_4 ⟶ Red Colour in Lower Layer.

3. Tri- Terpenoids

i. **Liebermann-Burchard Test:** Alcoholic Extract of Drug + Acetic anhydride, Boil & cool it. + Conc. H_2SO_4 in test tube ⟶ Brown ring formed at the junction of two layers and upper layer turns deep red colour.

ii. **Salkowski Test:** Alcoholic Extract of Drug + Conc. H_2SO_4 ⟶ Yellow Colour in Lower Layer [23].

3. Formulation of Polyherbal Cream

A. Formulation Table

Table 13: Formulation Table

S. No	Ingredients	Source	F1 (30 gm)	F2 (30 gm)
1	*Pergularia Daemia* Extract	Neoteric DCBA Ideas, Kumaran Garden, Vaiyampalayam, Coimbatore, Tamil Nadu, 641110	2.25 ml	2.17 ml
2	*Cissus quadrangularis* Extract	Mamta Vishwakarma, 1213, New Baselwa Colony, Old Faridabad, Haryana, 121002	0.75 ml	0.67 ml
3	Aloe vera gel	Aanchal Kesharwani, Bharat Nagar, Mohibullapur, Sitapur road, Lucknow, Uttar Pradesh, 226021	2.25 ml	2.17 ml
4	Curcumin Extract	Aurangabad ayurvedic medicine, Chhatrapati Sambhaji Nagar, 431001	0.75 ml	0.67 ml
5	Beeswax	YKH campus	4.5 gm	5.25 gm
6	Liquid paraffin	YKH campus	15 ml	14.25 ml
7	Borax	YKH campus	0.20 gm	0.45 gm
7	Methyl Paraben	YKH campus	0.03 gm	0.03 gm
8	Distilled Water	YKH campus	4.02 ml	4.17 ml
9	Orange Oil	YKH campus	0.25 ml	0.17 ml

B. Procedure

a. **Preparation of oil phase:** Bees Wax were melted it. Then add Liquid paraffin allowed to melt. The temperature of oil phase maintained between 65 – 70°C.

b. **Preparation of Aqueous phase:** Water was heated to 65 – 70°C. In this weighed methyl paraben and Borax were added the temperature of the phase was maintained at 65 – 70°C.

c. **Development of Cream formulation:** Then slowly add this aqueous phase to heated oily phase continuous stirrer at 65 – 70°C to mixed well.

d. Then add a measured amount of aloe Vera gel, *Pergularia Daemia* Extract, Cissus *quadrangularis* Extract and Curcumin Extract and stir vigorously until it forms a smooth cream.

e. Then add few drops of rose oil as a fragrance [24].

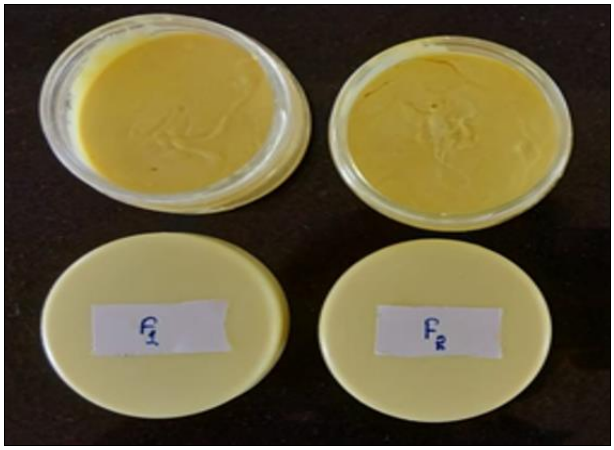

Fig 30: Formulation of polyherbal creams of F1 and F2

Evaluation of Polyherbal Cream

1. **Physical evaluation:** In this test, the cream was observed for colour, Odour, texture, state.
2. **Irritancy:** Mark the area (1 cm^2) on the left-hand dorsal surface. Then the cream was applied to that area and the time was noted. Then it is checked for irritancy, erythema, and edema any for an interval up to 24 h and reported.
3. **Washability:** A small amount of cream was applied on the hand and it is then washed with tap water.
4. **PH:** 0.5 g cream was taken and dispersed in 50 ml distilled water and then PH was measured by using digital PH meter.

Fig 31: PH meter

5. **Phase separation:** Prepared cream was kept in a closed container at a temperature of 25-100 ℃ away from light. Then phase separation was checked for 24 h for 10 d. Any change in the phase separation was observed/checked.
6. **Spreadability:** The Spreadability was expressed in terms of time in seconds taken by two slides to slip off from the cream, placed in between the slides, under certain load. Lesser the time taken for separation of the two slides better the Spreadability. Two sets of glass slides of standard dimension were taken. Then one slide of suitable dimension was taken and the cream formulation was placed on that slide. Then other slide was placed on the top of the formulation. Then a weight or certain load was placed on the upper slide so that the cream between the two slides was pressed uniformly to form a thin layer. Then the weight was removed and excess of formulation adhering to the slides was scrapped off. The upper slide was allowed to slip off freely by the force of weight tied to it. The time taken by the upper slide to slip off was noted.

$$\text{Spreadability} = m \times l/t$$

Where, m= Standard weight which is tied to or placed over the upper slide (30g),
l= length of a glass slide (5 cm)
t= time taken in seconds

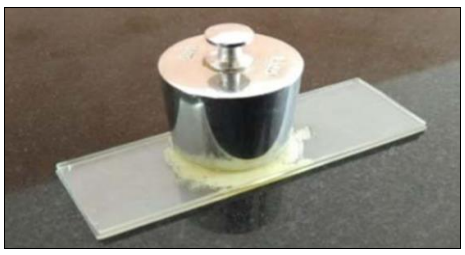

Fig 32: Spreadability

7. **Greasiness:** Here the cream was applied on the skin surface in the form of smear and checked if the smear was oily or grease-like.
8. **Microbiological studies:** Topical formulation with broad, non-resistance promoting activity against staphylococci, streptococci, dermatophytes or yeast or Molds can be of great use in dermatology preparation where infections are often mixed. Since formulation containing antimicrobial agents as active moiety, it is likely to protect from microbial growth. To determine the activity of formulation is subject to study the prepared formulation with standard method called Disk diffusion method and the inhibition zone diameters were measured with the help of zone reader.

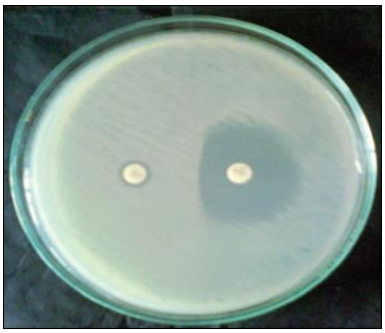

Fig 33: Against candida albicans

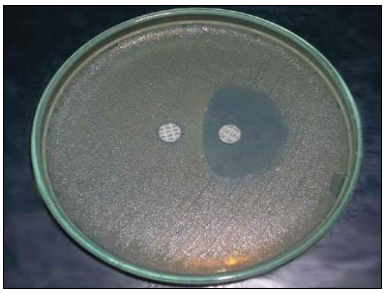

Fig 34: Against E. coli

9. **Homogeneity:** The formulation was tested for the homogeneity by visual appearance and by touch.

Result

A. Identification Tests Results

a. Identification test of Curcumin

Table 14: Identification test of Curcumin

S. No	Identification test	Observation	Inference
1	Curcumin Extract + H_2SO_4	Crimson Colour	Curcumin is present
2	Curcumin Extract + Boric Acid	Reddish Brown Colour	Curcumin is present
3	Curcumin Extract + Hcl	Pink Colour	Curcumin is present
4	Curcumin Extract + $Fecl_3$	Green Colour	Curcumin is present

b. Identification test of *Cissus quadrangularis*

Table 15: Identification test of *Cissus quadrangularis*

S. No	Identification test	Procedure	Observation	Inference
1.	**Carotenoids**			
i.	**Carr-Prize Test**	Alcoholic Extract of Drug + $Sbcl_3$ or $CHcl_3$	Blue colour.	β-Carotene is present.
2.	**Steroids**			
i.	**Liebermann-Burchard Test**	Alcoholic Extract + Acetic anhydride, Boil & cool it. + Add Conc. H_2SO_4 in test tube.	upper layer turns green	β- Sitosterol is present.
ii.	**Salkowski Test**	Alcoholic Extract of Drug + Conc. H_2SO_4	Red Colour in Lower Layer	β- Sitosterol is present.
3.	**Flavonoids**			
i.	**Shinoda Test**	Alcoholic extract of drug + Few Magnesium turnings + Conc. Hcl dropwise add.	Crimson red colour occurs	Kaempferol is present.
ii.	**Alkaline Reagent Test**	Alcoholic extract of drug + Few Drop NaOH solution	Intense yellow colour form	Kaempferol is present.
iii.	**Sulphuric acid**	Alcoholic extract of drug + Conc. H_2SO_4	Red colour occurs	Kaempferol is present.

c. Identification test of *Pergularia Daemia*

Table 16: Identification test of *Pergularia Daemia*

S. No	Identification test	Procedure	Observation	Inference
1.	**Terpenoids**			
i.	**Salkowski test**	Alcoholic extract of drug + Add few drops of Chloroform + Carefully added Conc. H_2SO_4 to form layer	Formed Reddish Brown colour of two layers.	α-amyrin & β- Amyrin are presents.
ii.	**Copper Acetate test**	Extract dissolved in water + added few drops of copper acetate	Formed emerald green colour	α-amyrin & β- Amyrin are presents.
2.	**Steroids**			
i.	**Liebermann-Burchard Test**	Alcoholic Extract + Acetic anhydride, Boil & cool it. + Add Conc. H_2SO_4 in test tube.	upper layer turns green	β- Sitosterol is present.
ii.	**Salkowski Test**	Alcoholic Extract of Drug + Conc. H_2SO_4	Red Colour in Lower Layer	β- Sitosterol is present.
3.	**Tri- Terpenoids**			
i.	**Liebermann-Burchard Test**	Alcoholic Extract + Acetic anhydride, Boil & cool it. + Add Conc. H_2SO_4 in test tube.	upper layer turns green	β- Sitosterol is present.
ii.	**Salkowski Test**	Alcoholic Extract of Drug + Conc. H_2SO_4	Red Colour in Lower Layer	β- Sitosterol is present.

B. Evaluation Parameters Results

1. Physical evaluation:

Table 17: Physical evaluation

S. No	Parameters	F1	F2
1	Colour	Pale Yellow	Pale yellow
2	Odour	Pleasant	Pleasant
3	Texture	Smooth	Smooth
4	State	Semi-Solid	Semi-Solid

2. Irritancy

Table 18: Irritancy

S. No	Formulation	Irritant effect
1	F1	Nil
2	F2	Nil

3. Washability

Table 19: Washability

S. No	Formulation	Washability
1	F1	Washable
2	F2	Washable

4. PH

Table 20: PH

S. No	Formulation	PH
1	F1	6.9
2	F2	6.8

5. Phase Separation

Table 21: Phase Separation

S. No	Formulation	Phase Separation
1	F1	No phase separation
2	F2	No phase separation

6. Spreadability

Table 22: Spreadability

S. No	Formulation	Time(sec)	Spreadability (g ×cm/sec)
1	F1	10	22.8
2	F2	7	32.4

7. Greasiness

Table 23: Greasiness

S. No	Formulation	Greasiness
1	F1	Normal greasy
2	F2	Normal greasy

8. Microbiological studies

Table 24: Microbiological studies

Bacteria	Candida albicans	E. coli
Zone of inhibition	42.32 mm	34.16 mm

9. **Homogeneity:** The homogeneity of the formulated cream was judged by the visual appearance and touch. The appearance and touch of the cream was good.

Discussion

Paronychia is a common infection of the skin around the nail, often caused by bacteria or fungi. The aim of formulating and evaluating a polyherbal cream from extracts of *Pergularia Daemia*, *Cissus quadrangularis*, Curcumin, and Aloe vera gel for paronychia treatment is significant for several reasons.

Firstly, *Pergularia Daemia* extract has been reported to possess antimicrobial and anti-inflammatory properties, which could help in combating the infection and reducing inflammation associated with paronychia. Similarly, *Cissus quadrangularis* extract is known for its antimicrobial and wound-healing properties, which could aid in faster recovery from paronychia.

Secondly, Curcumin, the active compound in turmeric, exhibits potent antimicrobial and anti-inflammatory activities. Its incorporation into the polyherbal cream could enhance its efficacy against paronychia, reducing both infection and inflammation.

Thirdly, Aloe vera gel is renowned for its wound-healing and anti-inflammatory properties. Its inclusion in the formulation can provide soothing relief and promote faster healing of the affected nail bed.

The combination of these herbal extracts in a polyherbal cream offers a synergistic effect, potentially providing a more comprehensive treatment approach for paronychia compared to conventional single-component therapies. Additionally, using herbal extracts may reduce the risk of adverse effects commonly associated with synthetic drugs.

Summary

Paronychia is a common infection of the skin around the nail, often caused by bacteria or fungi. Traditional treatments include topical and oral antibiotics, antifungal medications, and warm water soaks. However, the rise of antibiotic resistance and the desire for natural remedies have led to the exploration of herbal treatments for paronychia. The aim of formulating and evaluating a polyherbal cream from extracts of Pergularia Daemia, Cissus quadrangularis, Curcumin, and Aloe vera gel is to develop an effective, natural treatment option for paronychia.

Pergularia Daemia extract possesses antimicrobial and anti-inflammatory properties, which could help combat the infection and reduce inflammation associated with paronychia. Cissus quadrangularis extract is known for its antimicrobial and wound-healing properties, potentially aiding in faster recovery from paronychia. Curcumin, the active compound in turmeric, exhibits potent antimicrobial and anti-inflammatory activities. Its incorporation into the polyherbal cream could enhance its efficacy against paronychia, reducing both infection and inflammation. Aloe vera gel is renowned for its wound-healing and anti-inflammatory properties, providing soothing relief and promoting faster healing of the affected nail bed.

The combination of these herbal extracts in a polyherbal cream offers a synergistic effect, potentially providing a more comprehensive treatment approach for paronychia compared to conventional single-component therapies. Additionally, using herbal extracts may reduce the risk of adverse effects commonly associated with synthetic drugs. The formulation process involves selecting appropriate concentrations of each extract to maximize efficacy while ensuring safety.

Evaluation of the polyherbal cream involves testing its antimicrobial activity against common pathogens causing paronychia, such as Staphylococcus aureus and Candida species. Additionally, its anti-inflammatory effects can be assessed using *in vitro* study. Evaluation of polyherbal cream determine the efficacy in treating paronychia in human body.

Conclusion

The formulation and evaluation of a polyherbal cream from Pergularia Daemia extract, Cissus quadrangularis extract, Curcumin extract, and Aloe vera gel represent a promising step towards offering a natural and holistic solution for paronychia treatment. Pergularia Daemia extract, Cissus quadrangularis extract, Curcumin extracted by using Alcoholic Maceration method. Identification test for polyherbal cream for Bioactive Compounds was performed. Based on of plant bio factory for the production of highly potent such as microbial overgrowth, inflammation, and tissue repair compound in pharmaceutical industries. Polyherbal cream was prepared by using W/O method. This method was giving good result.

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